



U.S. Department
of Transportation
**Federal Aviation
Administration**

Memorandum

Subject: ACTION: Review and Concurrence, Equivalent Level of
Safety ; ACE-03-03

Date: December 1, 2003

From: Manager, Denver Aircraft
Certification Office, ANM-100D

Reply to: Melissa Sandow
Attn. of: (303) 342-1084

To: Manager, Small Airplane Directorate, ACE-100

The Denver Aircraft Certification Office is currently processing an application for a Type Certificate for the Liberty Aerospace Model XL-2 airplane. The purpose of this memorandum is to request your office to review and provide concurrence to an equivalent level of safety finding for installation of a design that permits the pilot to retain control of power inputs via redundant attachment features and periodic inspection rather than incorporating means such as a spring-loaded setting of the throttle, §§ 23.1143(g) and 23.1147(b).

Applicable Regulations:

23.1143(g) – For reciprocating single-engine airplanes, each power or thrust control must be designed so that if the control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.

23.1147(b) – For reciprocating single-engine airplanes, each manual engine mixture control must be designed so that if the control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.

Background:

The Liberty Model XL-2 is a 2-place, low wing, single-engine airplane with a 2-bladed fixed pitch propeller. The airplane will have a maximum gross weight of 1575 lbs (714 kg), stall speed of 44 knots, and a projected cruise speed of 119 knots. The airplane will be powered by a Teledyne Continental Motors (TCM) IOF-240-B engine rated at 125 hp (2800 rpm) at maximum continuous power. The engine has been FAA type certificated with a Full Authority Digital Electronic Control (FADEC) system to automatically control the ignition and fuel injection functions throughout the operational envelope.

Typical compliance with Sections 23.1143(g) and 23.1147(b) is shown by placing a spring on the throttle that will bring the engine to near full power in the case of a control disconnect. A landing is made by shutting off fuel to the engine once the airplane is in a position to make a safe landing at an airport.

Compensating Features:

The compensating features include a proposed design that addresses all identified modes of failure with a means to mitigate an unsafe condition:

1. Loss of retaining nut – dual means of retention: self-locking feature with split pin.

2. Failed rod end swage – incorporate secondary retention washer under bolt head (outboard/forward orientation).
3. Conditional anomalies – implement 100-hr/annual inspection requirement.

Applicant's Position:

Liberty proposes that by the use of positive retaining hardware, the possibility of control separation at the engine can be eliminated. This results in a configuration that is at least as safe as a design that has a possibility of a control disconnect and then uses another device to continue flight. This proposal is similar to previous ELOS findings made on other aircraft. It is believed that eliminating any chance of a disconnected control through positive retention hardware is safer than the possibility of an aircraft unexpectedly going to full power. This is particularly true on the ground in the proximity of personnel or obstructions.

Liberty further proposes that maintenance activities be prescribed to ensure integrity of the design over the life of the airplane, and the frequency of inspection is proposed to be 100h/annual. Liberty commits to further define the maintenance procedures for continued airworthiness of the XL-2 airplane as follows:

The TCM engine manufacturer's data for the IOF-240-B includes requirements for post-installation inspection. Chapter 5 of the Maintenance Manual for the IOF-240-series engines, dated November 2001, Section 5-5.4, prescribes inspection criteria sufficient for maintenance personnel to identify areas of concern, and instructions to service this engine control to restore aspects of performance. Additional guidance is offered to the airframe mechanic to provide unscheduled maintenance instruction, acceptable materials/lubricants, and final functional checks to support return to service. The Liberty maintenance manuals will promote all TCM inspection and instruction criteria, and combine it with any other inspections and instructional requirements not contained in the engine manufacturer's manual.

Maintenance of the XL-2 throttle cable linkage will not be limited to the engine attachment point. The Liberty XL-2 manual(s) will include inspection criteria for each termination and airframe interface required to ensure integrity of the control lever, lever pivot points, cable attach points, and proper functioning. Instruction for tension adjustments for initial and post maintenance service will be identified. Special tools and processes, area access instruction, dimensional limits, cleaning processes, repair and replacement instructions, installation and lubrication schedules, and interference evaluation will be incorporated in the Liberty manual(s) and supported by forms to promote proper documentation of the prescribed maintenance action in accordance with FAR Part 43.

FAA Advisory Circular AC20-143, Installation, Inspection and Maintenance of Controls for General Aviation Reciprocating Aircraft Engines, will be used extensively for content, completeness, accuracy, format, along with company experience and ingenuity to develop a robust and accommodating entry in the Liberty maintenance manual that is expected to be found prudent and acceptable for the type and kind of hardware selected for design.

Recommendation:

We concur that the Liberty proposed method for providing an equivalent level of safety envisioned by §§23.1143(g) and 23.1147(b) by utilization of an improved mechanical throttle connection and enhanced continued airworthiness requirements is acceptable, provided the following conditions are met:

1. Liberty provides a dual means of retention to prevent loss of the retaining nut.
2. Liberty incorporates a secondary retention washer under the bolt head that holds the rod end captive in the event of a failed rod end swage.
3. Liberty incorporates procedures in the maintenance manual as described in the Applicant's Position section of this memo. These procedures shall include inspection instructions to check for the security, condition, and proper functioning of the throttle control system, including the control lever, lever pivot points, and cable attach points. The requirement for this inspection shall be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness. The limitation shall specify that this inspection be performed annually for all airplanes and every 100 hours for airplanes requiring 100-hour inspections under the applicable operating rules, e.g. 14 CFR 91.409(b).

Ronald F. May

Concurred by:

Manager, Standards Staff, ACE-110

Date

Manager, Small Airplane Directorate
Aircraft Certification Service, ACE-100

Date